Technical collection

How to shed non-priority loads with a Compact NSX circuit breaker?

Equipment, diagrams and configurations required for the load-shedding function

Application note

Schneider Electric

Introduction

Load-shedding is one of the active energy efficiency actions.
Load-shedding, i.e. preventing some non-priority loads from being supplied during a certain period of time, can be used to supply power to an entire electrical installation by subscribing to the most appropriate contract possible with the electricity distributor, thereby saving money.
The advantages of energy efficiency are:

- lower consumption
- cost optimisation
- improved availability

Nowadays, this involves all the energy consumers: industries, buildings, shops or individuals.

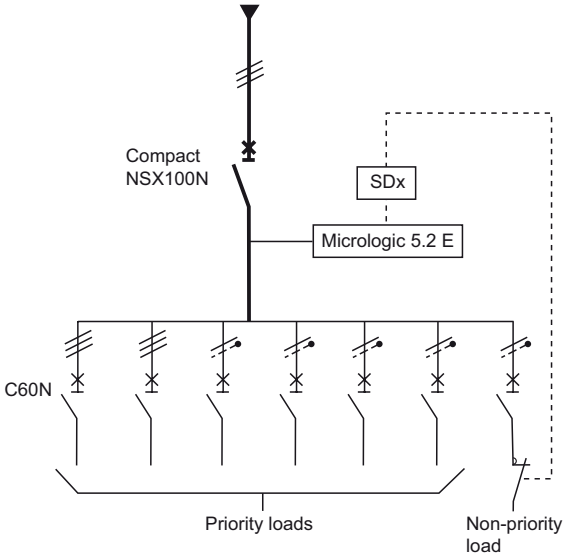
Load-shedding is used to:

- prevent overload tripping: if the load approaches the maximum load threshold, a load-shedding order on previously selected loads will prevent a general power failure throughout the installation (improved availability)
- subscribe to a lower level contract, whilst still guaranteeing that all the devices operate correctly
- carry the consumption forward to an off-peak tariff period (cost optimisation).

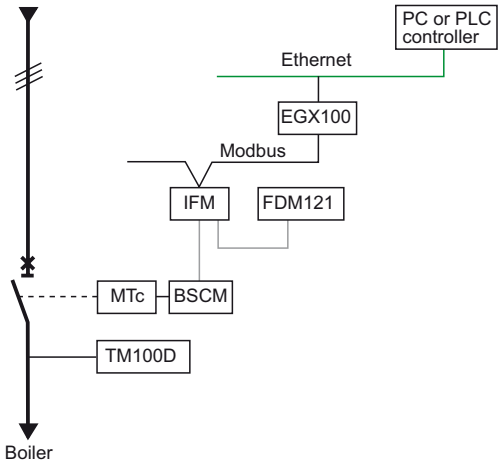
Two load-shedding solutions are provided:

- "reflex" load-shedding via a local order
- "centralised" load-shedding via a remote order

Reflex load-shedding



Centralised load-shedding

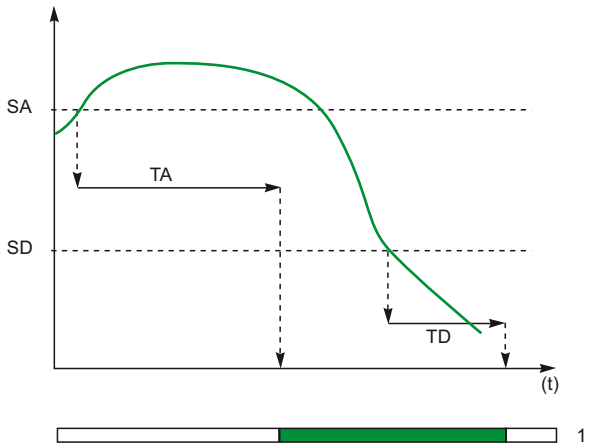


1. "Reflex" load-shedding via a local order

Description

The "reflex" load-shedding order is generated by the Compact NSX circuit breaker itself via the Micrologic electronic trip unit. In fact, the Micrologic E electronic trip unit (energy measurement) is used to manage alarms based on the monitoring of electrical variables such as the instantaneous current, the demand power (Pdmd) or even the frequency. An activation (pick-up) threshold (SA) with its time delay (TA) and a deactivation (drop-out) threshold (SD) with its time delay (TD) are associated with each alarm. The time delays are independent and can be set from 1 s to 3000 s.

The following figure illustrates the high alarm activation condition:



SA Activation threshold
TA Activation time delay
SD Deactivation threshold
TD Deactivation time delay
1 Alarm: activation zone (green)

Example 1: Load-shedding based on the instantaneous current threshold on a phase.
The detection of an instantaneous current high threshold overrun on a phase indicates an overload on this phase. Shedding a single-phase load connected to this phase prevents the circuit breaker from tripping on overload (long time delay) and therefore improves availability.

Example 2: Load-shedding based on a total demand power threshold (Pdmd).
The detection of an demand total power high threshold overrun indicates an overload on this installation. Load-shedding prevents the subscribed power from being exceeded and therefore optimises costs.

Example 3: Load-shedding based on frequency threshold (f).
The detection of a network frequency low threshold overrun in the event of the installation being operated by a diesel generator indicates an imbalance between the demand and the capacity of the generator. Load-shedding makes it possible to redress the balance and therefore to improve availability.

After configuring the thresholds, all that is required is to assign the alarm to output 2 on the SDx module (as output 1 is already assigned to the SDT long delay tripping notification).

SDx.

The "reflex" load-shedding order is therefore sent to the load-shedding contactor via the SDx module installed in the Compact NSX circuit breaker.
This load-shedding contactor (2-pole NC) cuts off the non-priority feeders.
This solution is therefore very easy to implement.

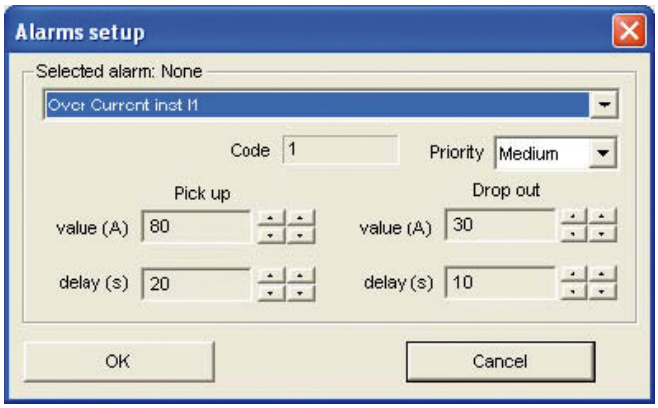
Products used

Product	Description	Cat. no.
Compact NSX100N	Three-pole breaking unit	LV429006
Micrologic	Electronic trip unit with energy measurement: Micrologic 5.2 E	LV429095
SDx	Two-output module	LV429532
CT	Two-pole contactor (2-pole NC) 20 A	15387

Configuration

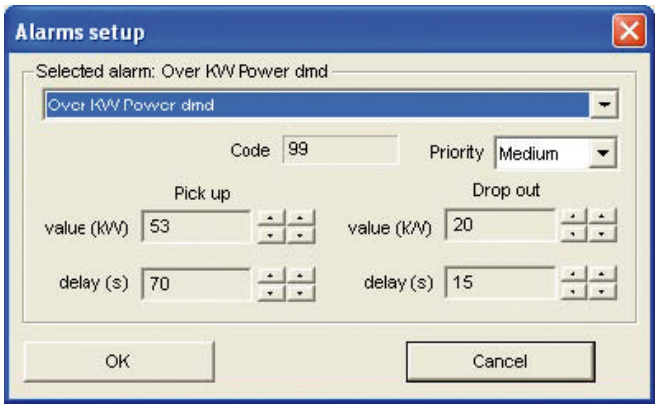
The alarms are configured using the RSU software (downloadable from schneider-electric.com)

Example 1: Load-shedding based on the instantaneous current threshold of the phase (I1).



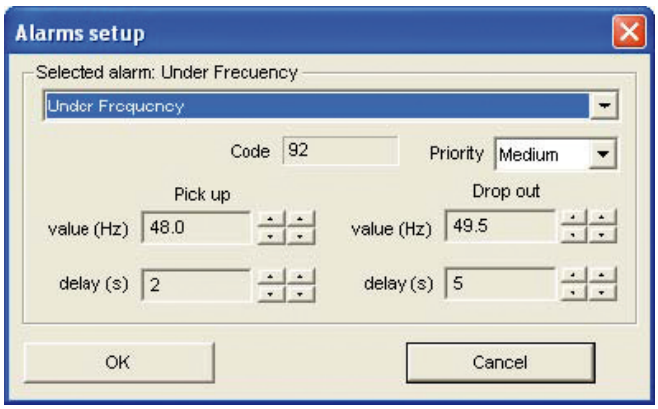
The load-shedding order is given as soon as the phase 1 current exceeds 80 A for more than 20 s.
This order will be maintained as long as the phase 1 current does not fall below 30 A for more than 10 s.
Note: To avoid beat phenomena, it is recommended that the difference between the high threshold (80 A) and the low threshold (30 A) should be greater than the current consumed by the shed load.

Example 2: Load-shedding based on a total demand power threshold (Pdmd).



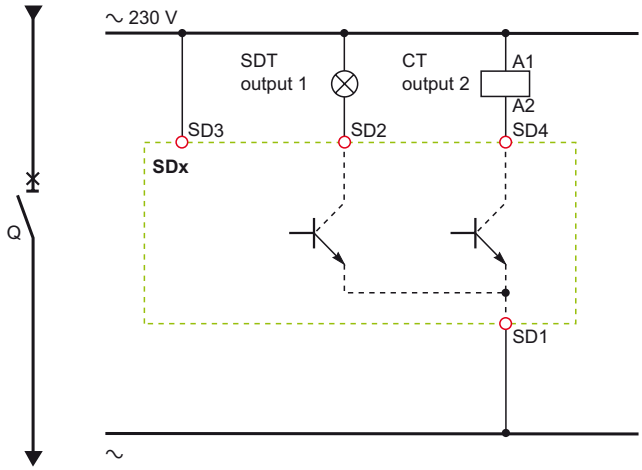
The load-shedding order is given as soon as the total demand power exceeds 53 kW for more than 70 s. This order will be maintained as long as the total demand power does not fall below 20 kW for more than 15 s.

Example 3: Load-shedding based on frequency threshold (f).



The load-shedding order is given as soon as the frequency falls below 48 Hz for more than 2 s. This order will be maintained as long as the frequency does not rise above 49.5 kW for more than 5 s.

Diagram



Test

It is easy to test whether the reflex load-shedding solution has been implemented by using the LSU (Local Simulation Utility) software. This software, which is available from schneider-electric.com, can be used to simulate the electrical variables (I, V, f, THD, phase shift angle phi). The USB port is connected via the maintenance module.

Connection via the USB port

1 Standard USB cable connecting the maintenance module to the PC
2 Maintenance module power supply unit
3 Micrologic cable connecting the maintenance module to the trip unit test socket

From the LSU software, a current is simulated on phase 1 (I1=83 A for example) and at the end of the activation time delay (20 s), it is noted that output 2 on the SDx module changes to 1 and therefore supplies the coil of the load-shedding contactor (CT) that will cut off the non-priority feeders. To change the SDx module output back to 0, a current of less than 30 A must be simulated on phase 1 for at least 10 s.

The same procedure can be followed for load-shedding solutions based on the power or frequency threshold.

2. "Centralised" load-shedding solution via a remote order

Description

The "centralised" load-shedding order is generated by the controller (PC or PLC).
The controller is used to generate load-shedding orders based on monitoring the electrical variables of the entire electrical installation, taking the time bands, operating constraints or even process-related information into consideration.
The "centralised" load-shedding order is sent to the BSCM module installed in the Compact NSX circuit breaker via the Modbus communication network.

BSCM.

The BSCM module is itself connected to the communicating remote control. The communicating remote control is the actuator that opens or closes the NSX circuit breaker.

Compact NSX with remote control.

The FDM 121 switchboard display unit can be added as an optional extra. In addition to displaying measurements, alarms and operating information, the FDM 121 can be used to give a local order to open/close the Compact NSX circuit breaker.
In remote mode, only orders from the controller are taken into account. In local mode, only orders from the display unit are taken into account. This ensures, for example, that no "unwanted" circuit breaker opening orders are received and that the closed position is maintained during a "critical" operation (backup, transfer of sensitive data, etc.).

FDM121.

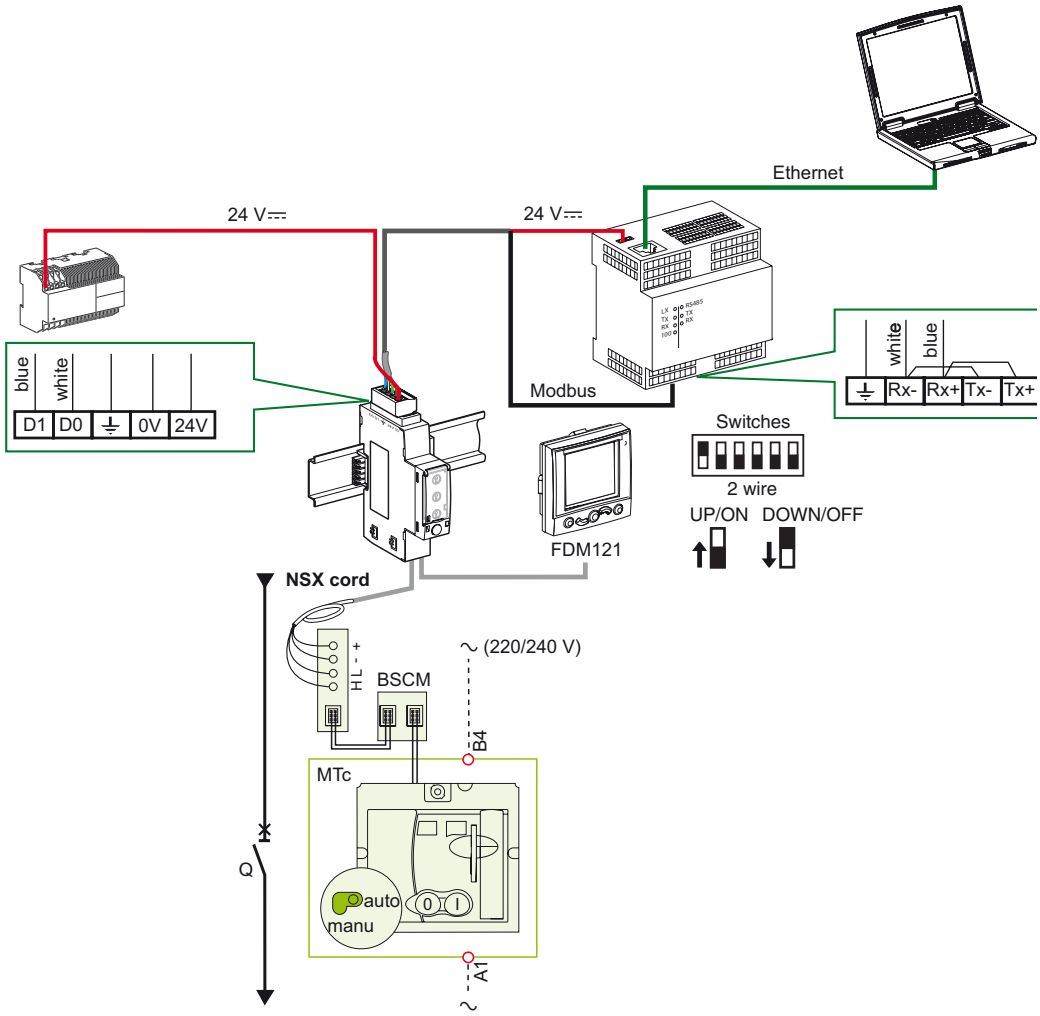
A powerful, flexible solution.

Products used

Product	Description	Cat. no.
Compact NSX100N	Three-pole circuit breaker fitted with a TM-D 100 A thermomagnetic trip unit	LV429840
MTc	Communicating remote control	LV429441
BSCM	Breaker Status Control Module	LV434205
NSX Cord	Length of wiring L=1.3 m	LV434201
IFM	Modbus interface	TRV00210
FDM121	Switchboard display unit	TRV00121
EGX100	Modbus/Ethernet communication gateway	EGX100MG

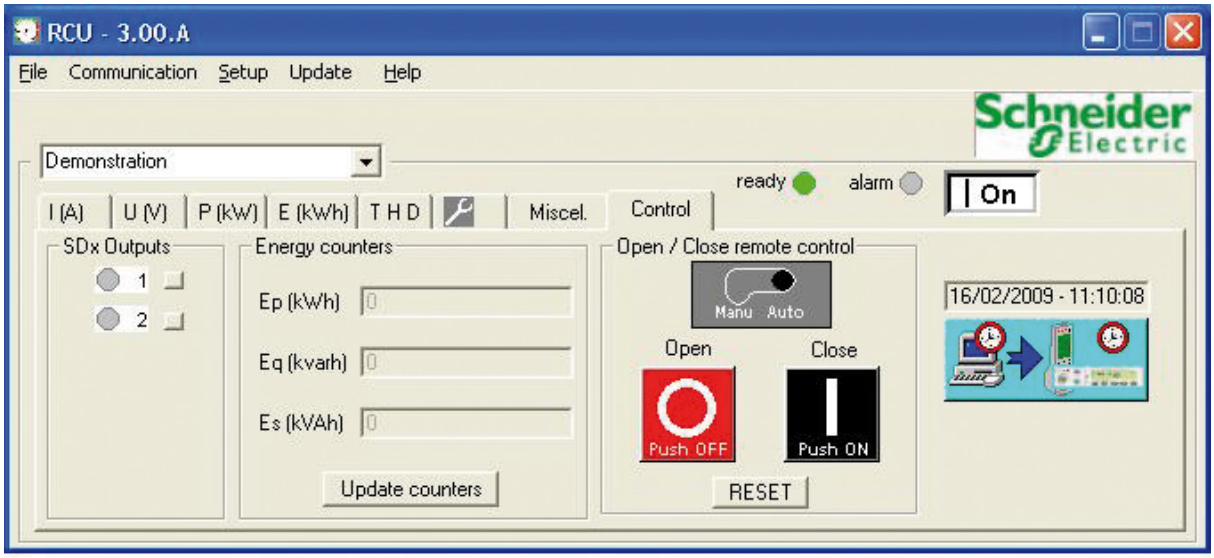
Configuration

No special configuration for the Micrologic. The load-shedding order (circuit breaker opening/closing) is sent by the controller to the BSCM module via the Modbus network. The configuration of the BSCM module Modbus circuit breaker opening/closing orders is specified in the Compact NSX Modbus operations guide (LV434106.pdf).



Test

It is easy to test whether the centralised load-shedding solution has been implemented by using the RCU (Remote Control Utility) software. This software, which is available from schneider-electric.com, can be used to open/close the Compact NSX circuit breaker via the communicating remote control. Connection to the PC Ethernet port is via the Modbus/Ethernet EGX communication gateway.
In the main set-up menu, go to the User profile submenu and choose "control". The control tab is now available and can be used to check that the communicating remote control is operating correctly over the Modbus network.



Conclusion

The "reflex" load-shedding solution via a local order with Compact NSX provides:

- a reduction in capital expenditure, as its purchase price is lower than that of a traditional solution: the cost of a Compact NSX with a Micrologic E trip unit (energy measurement) + SDx module is similar to the cost of a Compact NSX without the measurement function + Power Meter + I/O + CT. The difference is the cost of installing/wiring/testing the CTs, which is included in the Compact NSX.
- a reduction in operational expenditure, due to optimised energy costs and to the improved availability provided by the load-shedding function.

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